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Science, technology and innovation for enterprise development

Note by the UNCTAD secretariat

Executive summary

Technology and innovation, among others, are important means of implementing the 2030 Agenda for Sustainable Development because of their potential to drive innovative entrepreneurship that delivers growth and productive employment. Dynamic, innovative firms are also a key feature of successful industrialization strategies. Therefore, the development of science, technology and innovation (STI) capabilities among firms and entrepreneurs should be a focus of attention for policymakers. This note presents for the consideration of the Commission some elements of policies targeting STI capabilities at the firm level to promote the emergence of more technologically capable and innovative enterprises and ultimately, to raise productivity across all sectors of the economy. In particular, the note examines the main policy instruments used to address the financial constraints faced by innovative entrepreneurs, policies and practices to promote networking and clusters of innovative firms, and policy actions needed to leverage the opportunities for innovative entrepreneurship created by the emerging digital economy.

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I. Introduction

1. The 2030 Agenda for Sustainable Development will be fully achieved only if and when all countries, in particular developing countries, are able to apply knowledge and innovation more extensively to their social and economic processes. This has been the experience of those countries that have achieved significant catch-up in terms of income and human development, where that process has gone hand in hand with technological upgrading and enhanced innovation performance by their enterprises. Dynamic, competitive enterprises materialize structural transformation by introducing new and higher value activities. They generate more diverse exports that secure vital foreign currency. They also provide more and better jobs that facilitate social inclusion, and they introduce innovations that may reduce the environmental burden of production and consumption. It is therefore urgent to implement a policy agenda to generate and nurture innovative enterprises in developing countries.

2. Firms and entrepreneurs are at the centre of the innovation process. Any innovation reflects an entrepreneur's discovery of how an economic process could become more efficient and a decision to reorganize resources accordingly. If successful, this decision leads to a new product, service or process that will displace some previously existing activities and will involve a certain amount of socioeconomic change. It is the ease with which an economy enables entrepreneurs to constantly perform this unique reorganizing function that defines how effectively innovation will take place within it and how it will be able to fuel long-term growth.

3. Although the recognition of the overlaps between innovation and entrepreneurship goes back to Schumpeter's work of over a century ago, it is only relatively more recently that public policy has targeted in a purposeful manner the promotion of innovative entrepreneurship. While any form of entrepreneurship will have positive effects on employment in both developed and developing countries – hence the popularity of public policies aiming to stimulate the emergence of an entrepreneurial culture and to facilitate the creation and survival of new enterprises – it is the notion that innovative enterprises can make a crucially different contribution to economic growth and provide important technological inputs to other innovators in the economy that has brought increased attention to policies focusing on innovative entrepreneurship and its connection with technology and innovation policies.

4. Since much innovation also takes place within large established firms, innovation is not necessarily the strict domain of start-ups. Yet the connection between innovation policy on the one hand, and entrepreneurship policy on the other, tends to emphasize the support for new innovative, often technology-focused, high-growth potential firms and the creation of an economic and business environment in which such firms can emerge and thrive. Therefore, support measures become meaningful in the context of efforts to develop the technology-absorptive capacities of firms and organizations as part of an overall strategy to create and nurture national, regional or sectoral innovation system/s. Innovation systems include other critical elements such as research organizations, technology intermediators, intellectual property policies and institutions, norms, standard-setting bodies and regulatory frameworks. Policies related to the overall development of absorptive capacities and innovation systems in general constitute the core of STI policy for development and have been addressed extensively by UNCTAD in documents for the Investment, Enterprise and Development Commission and in recent flagship reports.[1] Within that general context, the following three areas are ones in which opportunities for collaboration and mutual reinforcement between STI and entrepreneurship development policies are more easily exploited:

[1] See UNCTAD, 2018, *Technology and Innovation Report 2018: Harnessing Frontier Technologies for Sustainable Development* (United Nations publication, Sales No. E.18.II.D.3, New York and Geneva).

(a) Addressing the financial constraints faced by innovative entrepreneurs;

(b) Facilitating the networking and clustering of innovative firms;

(c) Promoting new forms of entrepreneurship for the digital economy.

5. The remaining sections of this note, therefore, explore experiences and considerations for policymakers in each of the three areas. The note closes with some proposals of issues for consideration by the Commission.

II. Addressing the financial constraints faced by innovative entrepreneurs

Financing innovation

6. Finance plays a fundamental role in technological change and innovation.[2] The understanding of how innovation is financed has evolved along the same lines as the focus of STI policy. Traditionally, financing STI meant public spending on research and development or, less frequently, supporting or supplementing private research and development spending. Moving towards a more systemic understanding of innovation, the purpose of public financial support for STI broadened to include funding of mechanisms and infrastructures such as networks and clusters (see part III of this note) or public–private partnerships for early-stage funding. More recently, financing has become increasingly innovative, to wit the appearance of new funding mechanisms and the development of what is commonly referred to as the fintech sector.

7. Several new approaches to financing STI correspond to priority areas identified in the 2030 Agenda for Sustainable Development.[3] Impact investment, green funds, socially responsible investing, multi-stage financing and crowdfunding, among others, can make important contributions to development financing of the innovation needed to meet the Sustainable Development Goals. By themselves, financial innovations are, however, unlikely to be enough to fill the financing gap related to the achievement of the Goals, which is estimated at $2.5 trillion per annum.[4] From a development perspective and under conditions of financial scarcity, the main policy challenge is how to escalate the resources for innovative entrepreneurship and how to ensure that resources flow as a matter of priority towards innovative firms and industries with a strong transformative potential to accelerate the achievement of the Goals, including through technological upgrading and productivity enhancement.

8. This is a difficult challenge because a new entrepreneurial activity in the economic context of many developing countries will often be somewhat innovative in its environment. Even if many microenterprises and small and medium-sized enterprises (SMEs) in trade, retail and local services may not be technologically innovative, they will still create employment and increase earnings for entrepreneurs and employees. They may also be considered a safer bet from the perspective of organizations that finance start-ups and SMEs. These biases can reduce the potential broader societal and development benefits to be gained by channelling support towards more innovative firms.

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[2] UNCTAD, 2013, *World Investment Report 2013: Global Value Chains – Investment and Trade for Development* (United Nations publication, Sales No. E.13.II.D.5, New York and Geneva); UNCTAD, 2018, *Technology and Innovation Report 2018: Harnessing Frontier Technologies for Sustainable Development* (United Nations publication, Sales No. E.18.II.D.3, New York and Geneva).

[3] UNCTAD, 2018.

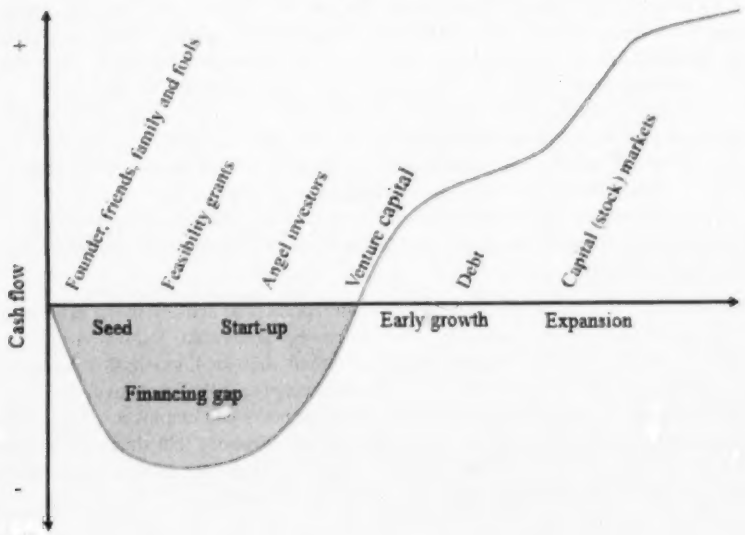
[4] UNCTAD, 2014a, *World Investment Report 2014: Investing in the Sustainable Development Goals – An Action Plan* (United Nations publication, Sales No. E.14.II.D.1, New York and Geneva).

Systemic lack of finance for innovation

9. The availability of financial capital and the operations of financial markets strongly influence the success of technology and knowledge-based economic growth and development.[5] Innovation often involves significant investments and is affected by spillover effects, information asymmetries, uncertainties and risks. Thus, innovative firms and entrepreneurs regularly encounter difficulties in securing financial resources. Finance for innovation in developing countries is also limited by smaller market sizes and consumer demand, inherently weaker financial sectors, reduced absorptive capacities of firms and fragmented policy support.

10. The fundamental problem of private funding for innovative firms is described in figure 1. Funding availability changes as a firm develops over time from a technology-absorbing and adapting start-up to a mature enterprise. Cash flow is initially negative and remains so during an initial period – up until the technology, product or process has been successfully developed and becomes commercially viable. It is during this period that financing is least available. In developing countries, firms often cannot use debt financing, as interest rates can be prohibitively high, and lenders may ask for security through pledged collateral that firms do not have. Access to funding is generally more limited for newly created enterprises, SMEs and microenterprises. The problem of financing technology affects new enterprises, as well as established ones seeking to carry out new projects. This is particularly true for start-ups based on information and communications technology (ICT) and knowledge, such as software and information technology services, whose main value lies in their invisible assets.

Figure 1
Cash flow and financing as an enterprise develops over time



Source: Based on Economic Commission for Europe, 2009, *Policy Options and Instruments for Financing Innovation: A Practical Guide to Early-stage Financing* (United Nations publication, New York and Geneva).

[5] W Kerr and R Nanda, 2014, Financing innovation, Working Paper, Harvard Business School; C Pérez, 2002, *Technological Revolutions and Financial Capital: The Dynamics of Bubbles and Golden Ages* (Edward Elgar Publishing, Cheltenham).

Funding mechanisms for innovation

11. The market failures affecting the funding of innovation are widely recognized and stem from spillover effects, asymmetries of information, uncertainties and commercial and technological risk. The result is that the market will allocate less resources to innovative activity than what would be optimal from a social perspective. There is therefore a clear role for public funding vehicles and programmes designed to target the financing gap illustrated in figure 1. To address deficient private funding, Governments can set up a variety of programmes and instruments for financing innovative activity in the early stages of development. They may also assist in the development of specialized financial intermediaries and encourage their participation in the early stages thereof. Funding instruments may involve direct or indirect support, or both. Enterprises may use public and private resources at the same time.

12. Table 1 lists various private and public direct and indirect funding instruments that can be used to facilitate the financing of innovative firms. Their interaction is not always straightforward, since certain funding instruments reinforce each other, while others may conflict with each other or produce mutual disincentives. Therefore, policymakers must evaluate their impact on the total availability of finance for innovation. Developing a monitoring and evaluation system, performance indicators and a programme for improving policy-learning processes are key challenges.

13. The origins and mechanisms for funding innovative activities vary at different stages in the life of a firm. The discussion below briefly describes some of these funding sources that may be of special importance for innovative firms and policymakers in developing countries.[6]

14. Venture capital financing involves acquiring shareholdings outside the capital market and by direct investment in emerging firms and sharing the risk of the commercial outcome. Unlike in some developed countries such as Germany and Japan, risk aversion among banks in developing countries limits their ability to provide debt finance to innovative start-ups and SMEs. For young and innovative firms, which face relatively high risks, equity investment in the form of venture capital may be a better match.[7] However, firms selling equity may lose control of their business and moderate their appetite for risk and innovation under pressure from an equity investor. Venture capitalists will monitor the skill, effort and performance of firms and entrepreneurs; they will lend assistance by providing better information sources (competing or complementary technologies, logistics, markets, values chains, for example) and means of linking up with other firms and organizations.[8] This function is usually not performed by other financing mechanisms.

[6] See UNCTAD, 2018 for a more extensive discussion.

[7] Organization for Economic Cooperation and Development, 2015.

[8] P Gompers, 1995, Optimal investment, monitoring, and the staging of venture capital, *Journal of Finance*, 50(5):1461–1489; S Kaplan and P Stromberg, 2003, Financial contract theory meets the real world: An empirical analysis of venture capital contracts, *Review of Economic Studies*, 70(2):281–315.

Table 1
Funding instruments, programmes and vehicles

Types of funding	*Personal savings and funds from relatives and friends*	
Private funding	Personal savings and funds from relatives and friends	
	Personal savings from parterns or employees	
	Microcredit	
	Crowfunding	
	Internal funding – reinvested earnings (profits)	
	Angel investors	
	Venture capital	
	Value chain financing	
	Impact investment	
	Loans from commercial banks	
	Stock markets	
	Impact investment, sustainable investment, socially responsible investment	
	Bonds (traditional)	
	Social impact bonds, green bonds	
Direct public funding	Public grants and subsidies	Innovation funds and technology funds
	Debt financing	Subsidized loans, repayable grants and credit guarantees
	Capital funding	Seed funding, funds of funds and co-investments funds
	Public procurement for research and development and innovation	
	Innovation vouchers	
	Innovation awards	
	Development bank instruments	
Indirect public funding	Tax incentives	Income tax incentives for enterprises
		Personal income tax credits
	Public spending on research and development	Competing research funds
		Enterprise–academia–government research and development partnerships
	International development assistance	

Sources: Based on Organization for Economic Cooperation and Development, 2015, New approaches to SME and entrepreneurship finance: Broadening the range of instruments, Final report, CFE/SME(2013)7/FINAL, 25 February; UNCTAD, 2013.

15. Successful venture capital also requires capital markets that can be used to spin off successful firms that have matured. In this sense, many developing countries are not well placed for private venture capital but may explore vehicles of public–private venture capital. However, this problem can be alleviated by providing access to initial public offerings on foreign stock markets or regional exchanges, or by establishing secondary exchanges (or junior markets) for SME listings, which can also create an additional channel for risk financing. This has been done in several of the larger and more advanced developing countries in Asia, such as China, India, Malaysia, the Philippines, Thailand and Viet Nam.[9] Some developing countries and emerging economies, such as Brazil, Chile, China, Taiwan Province of China, India, Mexico, the Republic of Korea and Singapore,

[9] Organization for Economic Cooperation and Development, 2015.

have attempted to develop venture capital markets. As well, venture capital funds are increasingly international in their investments.[10]

16. Impact investment aims to address social or environmental problems, while providing a financial return suitable for its strategic goals.[11] This includes community investment, directing capital to women and traditionally underserved communities, as well as financing businesses with clear social or environmental purposes.[12] Closely related concepts include sustainable investment and socially responsible investment funds. Impact and sustainable investments are estimated to have increased from $238 billion in 2014 to $579 billion in 2016. While a significant number of impact investors are involved in the venture stage, seed capital and start-up investments, such investments are relatively small in value terms.[13]

17. Innovation or technology funds are a major instrument for the public funding of innovation. They are often set up within existing organizations, such as development agencies or science and technology councils. Innovation funds work in two generic ways: through a full subsidy scheme, or through a scheme where both the funds and the firm contribute resources. Funding can be designed to target particular industries in line with national priorities or to achieve complementary policy goals, such as the promotion of innovation in SMEs, entrepreneurial culture, and collaboration among enterprises and between universities and firms.

18. Public procurement may be used to build productive capacity, generate demand for innovative goods and services through prior purchase commitments and develop innovative goods and services during pre-commercial stages. One of the difficulties in using public procurement is that procurement contracts are awarded primarily on the basis of the cost, low risk and proven technological maturity of products or services, rather than their innovative content.

19. Tax incentives allow a percentage of research and development expenditures to be deducted from tax liabilities. A tax credit is a deduction from the final tax liability, while a tax deduction is a reduction in the tax base. Many countries apply tax credits based on the volume of research and development expenditure. Policymakers may, however, have a broader focus and include other innovation expenditures. In evaluating the impact of tax incentives on actual innovation outcomes, three factors should be considered: the fiscal cost of tax incentives, the extent to which they stimulate an increase in research and development in industry and which enterprises (large, small, in which sector) can benefit from these tax incentives.

20. Public research and development spending at research institutes and universities is often the only significant research and development activity in many developing countries. Funding may provide knowledge that helps firms solve problems or adapt foreign technologies for efficient local use by firms. Such research and development may also provide new knowledge and technologies that can be transferred to firms as a basis for innovative activity.[14] These are conditional upon a well-designed and operational STI policy environment and a functional and linked-up national innovation system with broad stakeholder involvement.

[10] Economic Commission for Europe, 2009; Organization for Economic Cooperation and Development, 2011, *Financing High-growth Firms: The Role of Angel Investors* (Paris).

[11] Global Impact Investing Network, 2017, What you need to know about impact investing, available at https://thegiin.org/impact-investing/need-to-know/#s1 (accessed 27 March 2018).

[12] Global Sustainable Investment Alliance, 2016, 2016 Global Sustainable Investment Review.

[13] Global Impact Investing Network, 2017, Annual impact investor survey 2017, available at https://thegiin.org/research/publication/annualsurvey2017 (accessed 27 March 2018).

[14] UNCTAD, 2013.

21. Success in developing the innovative potential of an economy depends on the existence of a critical mass of growth-focused entrepreneurs and private investors. STI policymakers therefore need to appreciate the broad-ranging nature of the financial constraints and varying capacities of different types of enterprises, at different stages in their development and operating in different socioeconomic contexts. It is particularly important to understand that commercial banks – the predominant financial players in many developing countries – tend not to be a significant source of funding for innovative start-ups and SMEs. Commercial banks will rely on firms' collateral and established revenue streams to set up a loan: Innovative start-ups and SMEs have little or none of either.

22. Therefore, the focus of public policy needs to be on developing funding mechanisms or supportive mechanisms that will reduce risk and uncertainty for potential investors. Financing programmes should be designed in conjunction with other support measures, such as the creation of collaboration networks, coordination and the promotion of a business culture. While this may include public research and development spending, left on its own, this can often be a policy decision that leaves much to be desired. The key is to develop an appropriate mix of direct and indirect policy instruments that can address the specific financing concerns in a given country or region. Based on the various instruments listed previously, tax incentives, targeted procurement, public–private-partnership investment funds and venture capital vehicles could offer more potential.

III. Facilitating the networking and clustering of innovative firms

23. Inter-firm cooperation is an important mechanism for facilitating innovation and access to technology and markets. This is particularly prevalent in technology-related industries, where the private sector tends to be prominent in engaging in various types of cooperative agreements, such as joint ventures, joint research and development, technology exchange agreements, co-production, direct minority investments and sourcing relationships, to advance core strategic objectives. Building linkages between firms, along with public sector institutions and academia, can help upgrade capacities to generate, exploit, transfer and apply knowledge and can ultimately affect the performance of a national innovation system. One such policy is to encourage inter-firm collaboration in research and development and, more generally, in innovation, through networks and clusters. The local environment – economic, political, social and cultural – will have a strong influence on its success.

24. Networks and clusters are closely interlinked to one another but are different in nature. Networks are formal or informal alliances of firms and other actors that work together towards the same goal, while clusters are agglomerations of interconnected companies and associated institutions, typically within geographical proximity to each other. Networks can be established between firms within clusters but also exist outside clusters. They can be horizontal and vertical. Horizontal networks are built between firms that compete for the same market, such as a group of producers establishing a joint retail outlet. Vertical networks, particularly supplier development schemes, are alliances between firms belonging to different levels of the same value chain, such as a buyer assisting its suppliers for upgrading.[15]

25. In clusters, specialized enterprises that would otherwise compete with one another, work together to produce economies of scale and to benefit from the synergies that can be created. This type of territorial agglomeration is linked more to the concept of competitiveness, but it has gradually been incorporating the generation and dissemination of knowledge. To the extent that interdependence between players is created and knowledge can be exchanged, aggregation may lead to better technological development trajectories.

[15] See United Nations Industrial Development Organization, 2018, What are clusters and networks? Available at www.unido.org/our-focus/advancing-economic-competitiveness/supporting-small-and-medium-industry-clusters/clusters-and-networks-development (accessed 30 August 2018).

How networks and clusters work

26. The basic elements needed for clusters to work are trust and connectivity. When trust, which often stems from sociocultural identity, is shared by individuals and enterprises, it contributes to the achievement of shared goals, helps boost communication flows and strengthens cooperative efforts between producers. Connectivity refers to a cluster's ability to make connections with internal and external markets to increase continuously, the technological capacities of its products and processes.

27. Several factors influence innovation networks and clusters and therefore have an impact on key policy dimensions, including intellectual property rights, open innovation, globalization or fragmentation of production and technological change. Cooperation can offer several advantages. It can foster knowledge spillovers among actors and help to overcome coordination failures[16] by facilitating coordination between actors. It can also encourage a more effective pooling of financial and human capital resources for innovation resulting in economies of scales and can help support higher productivity and an increase in economies' competitiveness.[17]

28. However, there is evidence that not all linkages between players provide the same opportunities for knowledge generation, learning or innovation. For domestic enterprises that are part of global value chains, for example, technological learning opportunities will depend on the type of value chain to which they belong.[18]

29. Formal and informal partnering should be viewed as a continuum, where formal inter-firm cooperation, clustering and networking are perceived as alternative, and often complementary, modes of operation. The important consideration here is that the requirements of formal partnerships – including strategy formulation and significant partner contribution in tangible and/or intangible resources – may be placing the bar too high for the majority of mainly small firms in most developing countries. That leaves a whole spectrum of other cooperative interactions for these economic agents to pursue. More informal partnering through linkages, networks and clusters can be a way for many firms in developing countries to increase their sophistication and become stronger and more competitive, thus gradually preparing for more formal partnerships.

30. Governments can create or strengthen institutions and infrastructure to promote the effects of agglomeration and to increase the connectivity between enterprises and meso-organizations.[19] The first step in drawing up a strategy to promote clusters in a region must be to map the enterprises activity there, the institutions, the policy frameworks and their integration into global and local markets, to identify the causes of industrial dynamism in the existing or potential regions or places. Given that dynamic clusters are characterized by the creation of innovation, policies must take existing capacities and dynamics into account.[20] Further, they must consider a range of elements to develop the following characteristics of competitiveness:

(a) Nurturing interdependent relationships that are driven by market discipline;

(b) Encouraging government participation when public goods are involved and the building of trust and loyalty to extract social commitment from those involved (firms, meso-organizations and government);

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[16] Situations where business success is thwarted by a lack of coordination.

[17] See the Innovation Policy Platform, Innovation networks and clusters, available at www.innovationpolicyplatform.org/content/innovation-networks-and-clusters (accessed 30 August 2018).

[18] C Pietrobelli and R Rabellotti, 2011, Global value chains meet innovation systems: Are there learning opportunities for developing countries? *World Development*, 39(7):1261–1269.

[19] R Rasiah, 2007, The systemic quad: Technological capabilities and economic performance of computer and component firms in Penang and Johor, Malaysia, *International Journal of Technological Learning, Innovation and Development*, 1(2):179–203.

[20] M Best, 2001, *The New Competitive Advantage: The Renewal of American Industry* (Oxford University Press, Oxford); R Rasiah and J Vinanchiarachi, 2013, Institutional support and technological upgrading: Evidence from dynamic clusters in Latin America and Asia, *The Journal of World Economic Review*, 2:24–47.

(c) Fostering stakeholder coordination often helps to further the building of social capital;

(d) Promoting the training of human capital and creating the institutions necessary to stimulate innovation and competition;

(e) Facilitating the emergence of other players, including intermediary organizations such as suppliers, venture capitalists, property rights lawyers and marketing specialists, among others.[21]

31. A good example is the network of technological innovation centres in Peru that supports clusters and production chains. These technological innovation centres (*centros de innovación tecnológica*) are instruments designed to support the transfer of innovation and technology and provide technological services for companies in production chains. They contribute to innovation capacity, to the generation of added value and to the productivity and competitiveness of SMEs and of the production chains in which they are involved.[22]

Promoting collaboration through science, technology and innovation parks

32. STI parks can resolve two problems concerning innovation. First, the possibility for scaling up innovation is greater in an environment with numerous potential collaborators and a well-managed infrastructure. Second, operating in proximity with actual or potential collaborators enhances the ability of firms to learn, increase their absorptive capacity and develop their tacit and experiential knowledge more quickly and in greater depth.

33. STI parks are probably among the most widely used instruments to promote collaboration through clusters. Stanford Industrial Park, established on land owned by Stanford University near San Francisco in 1951, is considered the first such park and played a key role in the development of Silicon Valley. Today, there are approximately 400 STI parks in operation worldwide, including a significant number in developing countries.[23]

34. In China and India, innovation policies have adopted the strategy of creating STI parks at the national and regional levels. In China, 27 were originally set up in 1991, and by 2006, 53 national parks had been up and running for 10 years. By 2006, India had 47 software parks and 25 biotechnology parks. In most Latin American countries, parks are either in operation, being established or being designed.[24] Table 2 outlines the characteristics of the parks in the larger Latin American countries.

[21] UNCTAD, 2014b, *Studies in Technology Transfer. Selected Cases from Argentina, China, South Africa and Taiwan Province of China*, UNCTAD Current Studies on Science, Technology and Innovation No. 7 (United Nations publication, New York and Geneva).

[22] UNCTAD and Economic Commission for Latin America and the Caribbean, 2011, *Science, Technology and Innovation Policy Review: Peru* (United Nations publication, New York and Geneva).

[23] The International Association of Science Parks and Areas of Innovation currently has 347 members.

[24] A Rodriguez-Pose, 2012, *Los Parques Científicos y Tecnológicos en América Latina: Un Análisis de la Situación Actual* (Inter-American Development Bank, Washington, D.C.).

Table 2
Number, size and origin of science, technology and innovation parks in selected countries

	Operational	*Being set up*	*Planned*	*Size*	*Origin*
Brazil	22	31	11	Variable, from parks with over 100 firms and over 3,000 workers, to ones of less than one hectare and fewer than a dozen firms	Essentially public and federal, but with strong participation of state governments
Mexico	21	7	7	Variable, from one park which aspires to cover more than 4,000 hectares, to parks located in one building and with fewer than five firms	Mixed: private sector, state and federal governments, and academia
Argentina	5	2	3	Relatively small	Depend more on the private sector than the public sector
Colombia	5	2	3	Relatively small	National park development programme but with little take-up; two parks in operation outside the national programme
Venezuela (Bolivarian Republic of)	4	1	1	Small or medium-sized parks; some multi-site parks	Depend mainly on the public sector
Chile	2	2	2	Relatively small	Depend more on the private sector; universities play a leading role
Uruguay	1	1	1	Relatively small	Greater balance between public and private initiatives
Peru	0	0	7	Plans for medium-sized parks	Essentially public, with links to universities

Source: Rodriguez-Pose, 2012.

35. Some of the problems identified by Rodríguez-Pose (2012) in these Latin American parks are as follows:

(a) There is little sign that the parks are meeting their aims: There continues to be a lack of demand for them from the companies in the area where they have been set up, as local firms do not consider that they bring any added value;

(b) Few parks have been able to give rise to a transfer of knowledge from the research centres to the companies, or to generate changes either in production or in innovative activity in the area where they have been set up;

(c) Any physical structure geared towards the business environment is called a science and technology park, but at times they are SME incubators, industrial or business parks, or technology hubs with little technological content.

36. The experience of various developing countries suggests that, while STI parks have become a tool widely used to promote innovation, certain conditions must be met if they are to have an impact. The first requirement is the existence of leading professional bodies in knowledge and technology; if there are none, there must be a capacity to attract foreign technology firms, as well as domestic ones. Another essential condition is the existence of a national policy on developing an innovation system that promotes collaborative links and offers incentives to attract and support high-technology firms.[25] As pointed out in the study by Rodríguez-Pose on STI parks in Latin America, meeting these conditions is no easy task.

37. The management of an STI park must strive to go beyond its function of providing infrastructure and move on to developing skills to promote the incubation of new technology-based firms and contribute to the development of regional and sectoral innovation systems that maintain good relationships with public research bodies, enterprises and local industry. In Latin America, for example, the most dynamic STI parks with the greatest technological content are those situated around a region's best universities, in cosmopolitan areas where there is a critical mass of high-technology firms. Some STI parks, on the other hand, have been turned into enclaves that have few links with the local economy and transfer little technology to national industry.

38. Finally, science and technology parks should be distinguished from industrial estates, which are merely an agglomeration of enterprises – technology-based or otherwise – and do not necessarily include research bodies or technological institutes. Although STI parks in a developing country may resemble each other, their regulatory framework and support must be specific and focused, as the result expected of them is of a completely different order.

IV. Promoting new forms of entrepreneurship for the digital economy

39. The digital economy – the application of Internet-based digital technologies to the production and trade of goods and services – is becoming an ever more important part of the global economy. The transition to a digital economy can provide a boost to competitiveness across all sectors, new opportunities for business and entrepreneurial activity, and new avenues for accessing overseas markets – including linking domestic companies and SMEs to global value chains. It also provides new tools for tackling persistent development and social problems. However, it comes with a host of challenges – from the global digital divide, to potential negative social and development impacts and complex, Internet-specific regulatory issues – which policymakers need to address. The opportunities and challenges associated with the digital economy are particularly important for developing countries.[26]

40. New forms of entrepreneurship are emerging in a process of creative disruption of existing business models initiated by technological change. The key technologies and processes that predominantly give life to the digital economy are the following:

(a) Advanced production equipment, robotics and factory automation;

(b) New sources of data from mobile and ubiquitous Internet connectivity;

(c) Cloud computing;

(d) Big data analytics;

(e) Artificial intelligence.

[25] Rodríguez-Pose, 2012.

[26] UNCTAD, 2017a, *Information Economy Report 2017: Digitalization, Trade and Development* (United Nations publication, Sales No. E.17.II.D.8, New York and Geneva); UNCTAD, 2017b, *World Investment Report 2017: Investment and the Digital Economy* (United Nations publication, Sales No. E.17.II.D.3, Geneva); UNCTAD, 2018.

41. These technologies and processes are mainly based, in one way or another, on advanced ICT.[27]

42. Research suggests that digital adoption has the potential to transform the way companies across different industries run their internal operations, interact with customers and suppliers, and govern their international supply chains. It is the convergence of multiple technologies, as opposed to a single technology, that combine to enable firms to adopt new ways of doing business. The change agents are often not incumbent firms in each industry but instead new entrants, including SMEs, providing new digital technologies; suppliers which embrace digital opportunities to move up the value chain; and customers who are not only on the receiving end of a product or service but are actively co-creating it.

43. Major challenges brought by digitalization include the following:

(a) The digital divide – caused by a lack of investment, skills and capacity – makes digitalization a complex process, particularly for developing and least developed countries;

(b) Limitations to digitalization such as remote teaching or health services cannot fully be a substitute for physical schools and hospitals;

(c) Impact on employment, inequality, security and privacy: Governments must grapple with emerging regulatory challenges;

(d) Competition and consumer protection – developing countries, in particular the least developed countries, may risk increasing dependency on a few global digital multinational enterprises, or further marginalization from the global economy.

Building capacity for digital enterprises

44. While digitalization can help make trade more inclusive, gains are not automatic. An enabling environment with affordable Internet access, access to finance and reliable transport and logistics services is also essential. In developing countries and in the least developed countries, it is important to deal effectively with basic physical infrastructural issues; electricity supply, for example is essential to enabling wider Internet access.

45. Enterprises still need to ensure that their goods and services meet the quality standards and prices expected by potential clients. In this regard, adapting the work of trade promotion agencies is vital to help SMEs engage in the digital economy. Challenges include ensuring that entrepreneurs have the required capabilities to engage in e-commerce, in both domestic and cross-border trade, such as capabilities in digital marketing and the ability to comply with various trade rules. For example, ProMéxico, the export promotion agency of Mexico, which organizes seminars and training for SMEs, has created a business-to-business platform for SMEs selling to overseas markets. It offers consulting services to help them develop digital marketing strategies, online stores, online payment systems and social media engagement. Each company can request financial support of about $4,000 to help cover these costs. In Costa Rica, Promotora del Comercio Exterior (Procomer) has launched a service that brings together business-to-consumer and business-to-business sales channels and customers of three global platforms: iGourmet, Alibaba and Amazon.[28]

[27] UNCTAD, 2017a; UNCTAD, 2017b.

[28] Legiscomex.com, 2017, Procomer de Costa Rica presentó un nuevo servicio para exportar a través de e-commerce.

Need for digital skills

46. Greater reliance on digital technologies will lead to the creation of new jobs and occupations in various sectors, including in the production of new goods and services or existing products that respond to increased demand. The demand for skills can be expected to grow in areas such as data analysis, software and applications development, networking and artificial intelligence, as well as the design and production of new intelligent machines, robots and three-dimensional printers. For example, with the increasing use of the Internet of things, firms will need to hire more product managers; software developers, including for smart phones; hardware designers; data scientists; user experience designers; and sales managers.[29]

47. Similarly, there is likely to be job growth in pure digital firms. For example, in the United States, the number of employees in e-commerce firms without a physical retail shop rose by 66 per cent between 2010 and 2014, from 130,000 to 210,000.[30] Further, in Viet Nam, in August 2015, some 29,000 people were engaged in developing mobile applications.[31] As the digital economy grows, enterprises across sectors are likely to hire more people with skills related to cybersecurity. Estimates suggest that there are one million unfilled cybersecurity jobs worldwide and that by 2019, the number will have risen to 1.5 million.[32]

48. Considering these developments, the need for upgrading digital skills for both entrepreneurs and employees becomes inevitable if they are to create economic value in a digital future. Many different types of skills will be needed in the digital economy. The relationship between three distinct – but complementary – groups of digital skills can be represented in the shape of a skills pyramid (figure 2). Each group spans from basic to advanced skills. Enterprises seeking to enter the digital economy require more specialized and technical skills to produce digital and ICT tools. Those who apply, create or invent innovative business models and those who use digital and ICT tools and their applications require further skills. Developed and developing countries alike will need an adequate supply of these distinct types of skills to be able to fully exploit the digital economy.

49. In most developing countries, particularly in the least developed countries, the level of digitalization remains very low. Nevertheless, it is important to begin assessing the possible impacts of the digital economy and how Governments and enterprises may prepare for what lies ahead. A better understanding of the enabling conditions and implications of digitalization for the economy and society is urgently needed to maximize potential benefits and opportunities, and to cope with challenges and costs.

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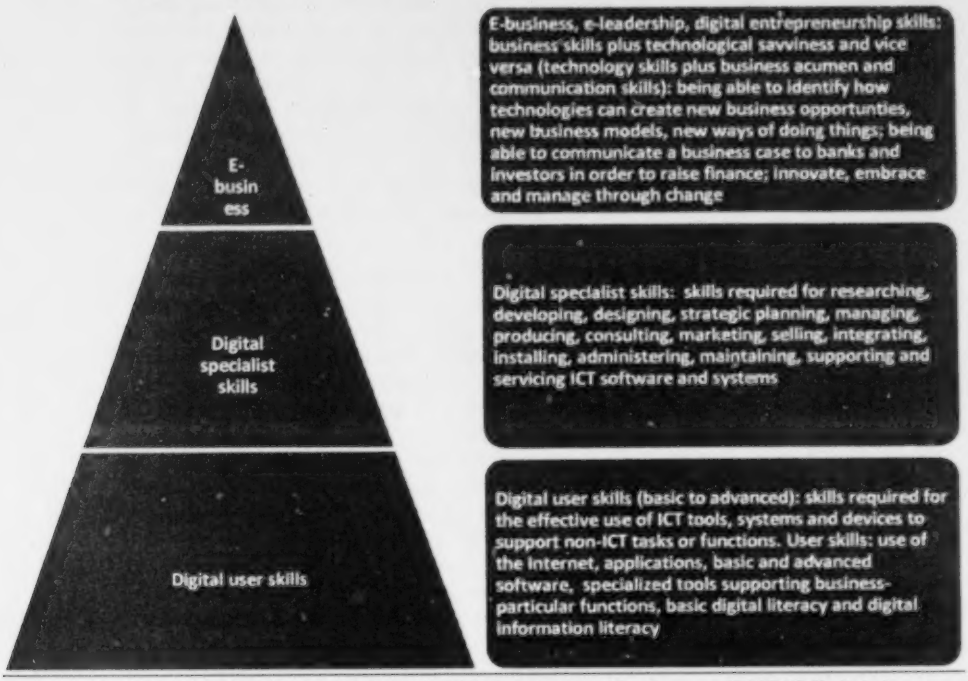
[29] See World Economic Forum, 2014, Six ways the Internet of things will affect our jobs, available at www.weforum.org/agenda/2014/10/internet-of-things-will-affect-our-jobs/ (accessed 29 August 2018).

[30] Data refer to electronic shopping (North American Industry Classification System code 454111), based on data from the United States Census Bureau, County Business Patterns.

[31] M Mandel, 2015, Viet Nam and the app [applications] economy, Progressive Policy Institute Policy Brief.

[32] See Indeed blog, 2017, Indeed spotlight: The global cybersecurity skills gap, available at http://blog.indeed.com/2017/01/17/cybersecurity-skills-gap-report/ (accessed 29 August 2018).

Figure 2
Digital skills pyramid


E-business
Digital specialist skills
Digital user skills
E-business, e-leadership, digital entrepreneurship skills: business skills plus technological savviness and vice versa (technology skills plus business acumen and communication skills): being able to identify how technologies can create new business opportunities, new business models, new ways of doing things; being able to communicate a business case to banks and investors in order to raise finance; innovate, embrace and manage through change
Digital specialist skills: skills required for researching, developing, designing, strategic planning, managing, producing, consulting, marketing, selling, integrating, installing, administering, maintaining, supporting and servicing ICT software and systems
Digital user skills (basic to advanced): skills required for the effective use of ICT tools, systems and devices to support non-ICT tasks or functions. User skills: use of the Internet, applications, basic and advanced software, specialized tools supporting business-particular functions, basic digital literacy and digital information literacy

Source: UNCTAD, 2017c, The "new" digital economy and development, UNCTAD Technical Notes on ICT for Development No. 8; European Commission, 2014, E-skills for Europe: Towards 2010 and beyond, European E-skills Forum Synthesis Report; D van Welsum and B Lanvin, 2012, E-leadership skills: Vision report, INSEAD [European Institute of Business Administration], Paris.

V. Issues for consideration

50. Many of the policies and instruments covered by this note have a record of practical application and evaluation, although this tends to be more widespread in developed countries. There is less knowledge and experience to guide policymakers in the design of policy mixes that address the development aspirations and requirements embodied in the 2030 Agenda for Sustainable Development and the material, technological, organizational and knowledge needs of firms and industries in developing countries. This requires a deeper interaction between policymakers and firms and entrepreneurs, and the development of a better understanding of both the role of innovative entrepreneurs in development strategies and of the specific operational constraints faced by innovators that policies should address. Capacity-building is needed at the level of firms – the Empretec programme developed by UNCTAD provides examples of best practice in this area – but also at the level of policymaking organizations. In this regard, the Commission may wish to discuss experiences in developing STI policies that fully incorporate the entrepreneurship dimension, including in terms of organizational and institutional approaches. It may also wish to promote the emergence of feedback loops for the monitoring and evaluation of policies, and address the role of international development cooperation and that of UNCTAD in particular in developing the policymaking- and policy-implementing capacity of developing countries in this area.

51. Mechanisms to finance innovative firms, such as innovation and technology funds, new types of bonds and crowdfunding, are increasingly implemented in developing countries, along with others such as venture capital, business angel finance and impact investment. Policymakers need to identify the best policy mix to differentiate among the financing needs of various categories of innovative firms, particularly in terms of their relationship with technology, since technological innovators may require differential treatment. In this regard, the Commission could consider experiences and practices in mobilizing funding for technological innovation, in particular the features and capabilities that are critical for achieving sustainable impact. A second issue that the Commission could explore is the role of international development funding in supporting innovative firms through innovation funds with a focus on the Sustainable Development Goals, especially in the least developed countries.

52. Another issue for consideration relates to digital entrepreneurship. The emerging digital economy creates opportunities for entrepreneurs from developing countries to enter new markets as more effective competitors than in traditional sectors. The development of ICTs also enables the emergence of new business models in developing countries that may offer more effective ways to address long-standing development challenges. Yet, how much this potential translates into real changes depends to a large extent on the ability of entrepreneurs to develop the underlying digital technology locally. This requires adequate digital infrastructure, sound digital regulation and fundamentally, as stated in this note, the existence of a broad base of digital skills. For example, the absence of the necessary coding skills is a source of fragility for the business expansion of successful digital entrepreneurs from developing countries. Digital skills will be critical for countries to produce their own regional and global players in the digital economy rather that becoming a mere user and consumer base for global players. The Commission may therefore wish to address in its policy dialogue the development of digital skills as a condition for the emergence of new forms of entrepreneurship in developing countries.